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Administrative, institutional and legislative issues on agricultural waste exploitation in Turkey

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Abstract

In this study, the influence of non-technical issues on the exploitation of agricultural waste in Turkey was investigated in accordance with the work program requirements for the project entitled "Exploitation of Agricultural Waste in Turkey" under the EU Life Third Countries Program. The study has been organized and presented according to the following four phases: (i) study of existing Turkish legislation and the administrative and institutional framework, (ii) review and analysis of the EU policy and legislation relevant to agricultural waste, including identification of potential market instruments, (iii) identification of barriers to the promotion of agricultural waste exploitation in Turkey, and (iv) Identification of gaps and formulation of recommendations. An ultimate objective of this study is to transfer the European experience and practices relative to the overall framework of managing agricultural waste.

Keywords: Renewable energy sources; Biomass; Agricultural waste; Legislative issues; Energy policies; Environmental policies

Contents

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1. Introduction

Historically, the agricultural sector has been Turkey's largest employer and a major contributor to the country's gross domestic product (GDP), exports and industrial growth. As the country develops, agriculture declines in importance, however it still accounts for a relatively large share of total output and employment compared to many other countries. Indicatively, the export of agricultural commodities (excluding agroindustry) for 2005 was about 2 billion USD, or 10% of total Turkish exports. Agriculture accounted for 16% of the country's GDP for the same year [1].

Crops and livestock represent almost 90% of the agricultural sector in Turkey, with forestry and aquaculture contributing the rest. The type and quantity of crops that form the basis of the agricultural sector in Turkey (wheat, barley, tobacco, cotton, rice, etc.) give rise to huge amounts of agricultural residues [2]. These residues are treated in an uncontrolled manner—either burned in open-air fires or disposed of and left to decay. In both cases, these management methods give rise to significant environmental impacts and, at the same time, waste useful energy resources that could reduce dependence on imported fuels [3].

Total energy consumption in Turkey in 2004 was 87,818 Mtoe [4]. Of this amount, 67% was provided through imported resources such as petroleum, coal, and natural gas. Domestic and renewable energy resources accounted for 27% of the supplied demand, while wind, solar, hydro, and biomass energy accounted for 16.5%. Agricultural waste (also referred to as agro waste), which is included under the biomass energy classification, has been used on a very small scale. However, Turkey has a great potential for supplying and applying agro waste and other renewable energy resources [5–6]. By using these

resources, Turkey will decrease not only its dependence on imported resources but also environmental emissions. In addition to technological developments, legal arrangements will accelerate the use of these resources.

The objective of this study is to examine the influence of non-technical issues on the exploitation of agricultural waste in Turkey. Such issues cover the legislative framework and the organizational structure of the Turkish administration relevant to waste exploitation. A further objective is to transfer the European experience and practices relative to the overall framework of managing agricultural waste.

2. Study of existing Turkish legislation

Existing Turkish law and regulation with relevance to the use of renewable energy sources is limited to two pieces of legislation. One piece of legislation is the Electricity Market Licensing Regulation, and the second is the Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy. As indicated by the titles, this legislation has been developed for the electricity sector. In both regulations, biomass is included in the definition of renewable energy resource. There is no legislation currently existing for biomass alone.

2.1. Energy Market Licensing Regulation

According to the Electricity Market Licensing Regulation, promotion of renewable energy sources in the electricity market has been assigned to the *Energy Market Regulatory Authority*. Specifically, the Regulation states that the issues assigned to the Energy Market Regulatory Authority are "With regard to the environmental effects of the electricity generation operations, to take necessary measures for encouraging the utilization of renewable and domestic energy resources and to initiate actions with relevant agencies for provision and implementation of incentives in this field". In this context, there are some incentives and regulations related to renewable energy sources. The incentives brought into existence based on the Electricity Market Licensing Regulation are given below [7]:

a) *Licensing fee reductions and waivers*: entities applying for licenses for construction of facilities based on domestic natural resources and renewable energy resources shall pay only 1% of the total licensing fee. The generation facilities based on renewable energy resources shall not pay annual license fees for the first 8 years following the facility completion date indicated on their respective licenses. Lengthy construction delays may disqualify the facility from the fee waiver.
b) *Priority distribution connection*: Turkish Electricity Transmission Company (TEIAS) and/or distribution licensees shall assign priority for system connection of generation facilities based on domestic natural resources and renewable resources.

2.2. Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy

According to the law, Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy, no. 5346, dated May 10, 2005, its purpose is to increase the

use of renewable energy sources for generating electrical energy, as well as to diversify energy resources, reduce greenhouse gas emissions, assess waste products, protect the environment, and develop the necessary manufacturing sector for realizing these objectives [4].

The biomass definition given in this law reads:

> *Biomass*: The fuels in solid, liquid or gaseous phase obtained from organic wastes and from the agricultural and forestry products including the waste products of agricultural harvesting and oil extraction from plants as well as from the by products formed after their processing.

Specific incentives written in the law that are applicable to the use of biomass include:

a) Obligation to purchase electricity from renewable energy sources: Within the framework of prepared price or fee by the Ministry, the relevant information on renewable energy source-certified (RES-certified) electrical energy, which shall utilize the implementations included in this law, shall be issued by *Energy Market Regulatory Authority* (EMRA) annually. Each legal entity possessing a retail sale license shall be required to purchase RES-certified electrical energy in an amount declared by EMRA considering the proportion of the energy the entity has sold within the previous calendar year to the total electrical energy which all legal entities possessing a retail sale license offered for sale in Turkey.
   In case the total electrical energy amount with an RES-certificate is sufficient, the legal entities possessing retail sale license shall be required to purchase RES-certified electrical energy not lower than eight percent of the electrical energy they have sold in the previous calendar year.
b) Purchasing of electricity from renewable energy sources with a higher price: Until the end of 2011, the applicable price for the electrical energy to be purchased in pursuance with this law within each calendar year shall be the Turkish average wholesale electricity price in the previous year determined by EMRA. The Council of Ministers is entitled to raise this price up to 20% at the beginning of each year. As of the end of 2011, this pricing methodology shall not be applicable for the RES-certified electrical energy generation plants that are in operation for more than 7 years.
c) *Acquisition of land*: In the case of utilization of property which is under the possession of Forestry or Treasury or under the sovereignty of the State for the purpose of generating electrical energy from the renewable energy resources included in this law, these territories are permitted on the basis of its sale price, rented, given right of access, or usage permission by the Ministry of Environment and Forestry or the Ministry of Finance. A 50% deduction shall be implemented for permission, rent, right of access, and usage permission in the investment period.

3. Study of the administrative and institutional framework

The administrative and institutional framework was considered for Turkey's three relevant governmental policy areas: Agriculture, Environment, and Energy. Relevant institutions in each area are identified below.

3.1. Agricultural Policy Institutions

The Ministry of Agriculture and Rural Affairs (MARA) is the main governmental institution in Turkey with responsibility for the development and execution of agricultural policy. MARA is a ministry that was founded under the law numbered as 441, enacted on August 7, 1991, and promulgated and entered into force on August 9, 1991, as found in the Official Gazette no. 20955. MARA was founded to create development plans and programs for the development of villages, to provide for the development of agriculture and stockbreeding and to implement agricultural, social and economic public services in the duty area [8].

3.2. Environmental Policy Institutions

The Ministry of Environment and Forestry (MEF) is the main institution in Turkey with responsibility for the development and execution of environmental policy [9]. MEF was founded under the frame of regulations and provisions of the law numbered as 4856, enacted on May 1, 2003, and promulgated and entered into force on May 8, 2003, as published in the Official Gazette no. 25102.

3.3. Energy Policy Institutions

Ministry of Energy and Natural Resources (MENR) is the only institution, responsible for constitution and execution of energy policies in Turkey. MENR is a ministry that has been founded under the frame of regulations and provisions of the Law, numbered as 3154, enacted and promulgated on May 8, 2003 and on the Official Gazette no: 18681 and entered into force on that date.

The foundation aim of MENR is to help determination with related goals and policies of energy and natural resources, in the direction of development and strengthen of national economy, defense of the country, security and prosperity; to assure to get researches on development, production and consumption of energy and natural resources, in accordance with this target and policies.

Ministry of Energy and Natural Resources (MENR) come into existence center organization and connected and related institutions [4].

4. Review and analysis of EU policy and legislation relevant to agricultural waste

Existing EU policy and legislation relevant to agricultural waste was reviewed for purposes of understanding the current status of agricultural waste management and exploitation in the EU, where policies on this issue are more developed than anywhere else in the world. Related policy and legislation were found to exist in each of the three relevant policy categories: Agriculture, Environment, and Energy. The summary of findings is presented below according to these categories in Sections 4.1, 4.2, and 4.3, respectively [10–14]. It should be noted that energy recovery from agricultural residues and waste is consistently supported in each policy area.

4.1. Relevant Agricultural Policy and Legislation in the EU

One EU agricultural policy and four relevant EU agricultural regulations were found with relevance to agricultural waste management and exploitation. These are summarized in Table 1 [10]. Overall, these pieces of legislation promote efficiency and environmental protection in the management of agricultural by-products and waste, especially in the form of renewable energy (i.e. biomass energy) development.

4.2. Relevant Environmental Policy and Legislation in the EU

Four EU environmental directives were found that had relevance to agricultural waste management and exploitation. These are summarized in Table 2 [11–13]. Included are some specific emission limits for large combustion plants operated with biomass. Other pieces of legislation encourage recycling, re-use, and reclamation of agricultural (and other) wastes, including reclamation of waste for energy recovery. In the Landfill Directive, targets are established to reduce the amount of biodegradable wastes sent to landfills. Explicitly encouraged alternative management methods include composting, biogas production, and material/energy recovery.

Along with the requirements of the EU Landfill Directive, several countries have also introduced landfill taxes (e.g., Austria, Belgium, France, Denmark, Netherlands, UK).

Table 1
EU agricultural policy/legislation with relevance to agricultural waste

Legislation ID	Summary/selected excerpts
Common Agricultural Policy (CAP) and Associated Council Regulation	"Agenda 2000" of the CAP—refers to the encouragement of renewable energies, especially biomass; future modifications to the policy will include major emphasis on alternative uses of agricultural products Rural development policy will also stress renewable energy sources *Relevant Council Regulation* was adopted in September 2003. As a result, farmers will be paid independently of what or how much they produce. In the past, the more farmers produced, the more subsidy payments they received. Under the reformed CAP, farmers will still receive direct income payments to maintain income stability, but the link to production has been severed. This means that agricultural production at the EU level will be market-driven—part of production could be directed toward the production of biofuels
Animal By-Products Regulation (EC 1774/2002)	Rules for collection, transport, storage, handling, processing, and use or disposal of animal by-products (including manure and digestive tract content) (These topics are excluded from the scope of the Waste Framework Directive)
Regulation on improving the processing and marketing conditions for agricultural products (951/97)	Includes financial incentives (funding) for encouraging better use of by-products, particularly by recycling of wastes and adoption of new technologies relating to environmental protection, renewable energy, and efficiency
Agro-Environmental Measures Regulation (2078/92)	Establishes a Community aid scheme to promote environmentally favorable practices

Source: Ref. [10].

Table 2
EU Environmental policy/legislation with relevance to agricultural waste

Legislation ID	Summary/selected excerpts
Waste Framework Directive (75/442/EEC as amended by 91/156/EEC)	Stresses recycling and re-use, and mentions use of waste as a source of energy "Member States shall take appropriate measures to encourage: … (i) the recovery of waste by means of recycling, re-use or reclamation, or any other process with a view to extracting secondary raw materials, or (ii) the use of waste as a source of energy" "Member States shall also take the necessary measures to prohibit the abandonment, dumping or uncontrolled disposal of waste" Decision 2000/532/EC establishes the European Waste Catalogue (EWC), pursuant Article 1(a) of Directive 75/442/EEC. Among the waste types included in the EWC, the following could be relevant: • 02 Wastes from Agricultural, Horticultural, Hunting, Fishing and Aquacultural Primary Production, Food Preparation and Processing o 020103 Plant tissue waste o 020107 Waste from forestry exploitation When waste is used for energy generation, care must be taken to remain in compliance with these waste management regulations Excluded from the scope of this Directive: "animal carcasses and the following agricultural waste: faecal matter and other natural, non-dangerous substances used in farming"
Waste Incineration Directive (2000/76/EC)	This Directive excludes incineration plants exclusively treating biomass. Specifically, per Article 2, the following are excluded from this Directive: (a) Plants treating only the following wastes: (i) vegetable waste from agriculture and forestry, (ii) vegetable waste from the food processing industry, if the heat generated is recovered, (iii) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered, (iv) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood-preservatives or coating, and which includes in particular such wood waste originating from construction and demolition waste, (v) cork waste, (vi) radioactive waste, (vii) animal carcasses as regulated by Directive 90/667/EEC without prejudice to its future amendments, (viii) waste resulting from the exploration for, and the exploitation of oil and gas resources from off-shore installations and incinerated on board the installation; (b) Experimental plants used for research, development and testing in order to improve the incineration process and which treat less than 50 tonnes of waste per year. However, Directive has air emission limits (using a mixing rule formula) in Annex II with relevance to biomass combustion plants that co-incinerate waste. Includes dioxin/furan limits. (This Directive, including Annex II, is attached as Appendix 4 to this report)
Large Combustions Plants Directive (LCPD)—on the limitation of emissions of certain pollutants into the air (2001/80/EC)	Explicit emission limits for large combustion plants operated with biomass are given in Annexes (SO_2, NO_x and dust) SO_2 [mg/Nm^3 (O_2 content 6%)] 50–100 MWth — 100–300 MWth — >300 MWth 200 — 200 — 200 NO_x [mg/Nm^3 (O_2 content 6%)] 50–100 MWth — 100–300 MWth — >300 MWth

Table 2 (*continued*)

Legislation ID	Summary/selected excerpts		
	400	300	200
	Dust [mg/Nm^3 (O_2 content 6%)]		
	Plants licensed and operating by 27 November 2003:		
	<500 MWth	$>=500$ MWth	
	100	50 (100 if specified exceptions are met)	
	Plants initiating operations after 27 November 2003:		
	50–100 MWth	>100 MWth	
	50	30	
Landfill Directive (1999/31/EC)	Establishes a target of 65% reduction in biodegradable municipal waste going to landfills (by weight, relative to 1995 waste production data) by the year 2016. Interim targets of 25% and 50% are also given for 2006 and 2009, respectively. Encouraged methods to achieve these targets are: recycling, composting, biogas production, and materials/energy recovery		

Source: Ref. [11–13].

Several thousand industrial sites in Europe produce significant quantities of biomass residues; therefore, such taxes are being imposed to provide incentives for alternatives to disposal.

In addition to the noted legislation, it should be stated that European countries are committed to meeting the challenge of their CO_2 reduction targets in order to reduce global warming. Policy efforts to support this are woven into various pieces of legislation. The EU is committed to reducing its CO_2 emissions to 8% less than 1990 levels during the Kyoto first commitment period, 2008–2012, and this burden is shared amongst Member States. Proper management and environmentally sound exploitation of agricultural waste will support the EU in achieving these important goals.

4.3. Relevant Energy Policy and Legislation in the EU

Four EU energy-related directives and one especially important Communication from the Commission (White Paper) were found that had relevance to agricultural waste exploitation. Overall, these legislative and policy development documents encourage renewable energy development and have relevance for electricity production, heat, and transport fuels. While each directive and the Communication are applicable to essentially all renewable energy sources, some specific incentives and targets are given in support of biomass energy and biofuels. Each of the directives and the Communication are summarized in Table 3 [14].

5. Identification and assessment of potential policy and market instruments

To set the stage for a discussion of policy and market instruments, it is important to clarify the overall, underlying drivers—or motivations—for exploitation of agricultural waste. Therefore, these drivers are introduced in Section 5.1, followed by potential agricultural, environmental, and energy policy and market instruments in Sections 5.2, 5.3, and 5.4, respectively. Research and development incentives are also significant for promoting agricultural waste exploitation, and these are covered in Section 5.5.

Table 3
EU Energy policy/legislation with relevance to agricultural waste

Legislation ID	Summary/selected excerpts
Directive on the promotion of electricity produced from renewable energy sources (RES) in the internal energy market (2001/77/EC)	Closely tied to the White Paper on Renewable Energy Sources (RES) (Communication COM(97)599 final, listed below). Upholds EU target given in the White Paper of 12% penetration of renewables into the gross domestic energy consumption by 2010, which translates into a specific share for RES-electricity consumption of 22.1% Emphasizes transition periods of *governmental support* in order to maintain investor confidence Mentions that directives related to electricity production must also be reviewed for barriers to RES—report on this was scheduled for October 2003
Directive on the common rules for the internal market in electricity (96/92/EC)	States that "…for reasons of environmental protection, priority may be given to the production of electricity from renewable sources" Article 8(3) permits Member States to require electricity from renewable sources or waste to be given priority when dispatching generating installations
Directive on Restructuring the Community Framework for the Taxation of Energy Products and Electricity (2003/96/EC)	Allows Member States to *apply total or partial exemptions or reductions in the level of taxation to electricity produced by biomass* "Biomass" shall mean the biodegradable fraction of products, waste and residues from agriculture—including vegetal and animal substances, forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste
Directive on Promotion of the Use of Biofuels or Other Renewable Fuels for Transport (2003/30/EC)	Sets reference targets for Member States. Calls for *2% by end of 2005 and 5.75% by end of 2010* (calculated on basis of energy content) *as the minimum proportion of biofuels on the market* for all gasoline and diesel sold for *transport*
Communication from the Commission	Policy Instruments Identified:
Energy for the Future: Renewable Sources of Energy	*2010 RES targets*: Increase from the current 6% to 12% penetration of renewables in the EU by 2010 ("an ambitious but realistic objective" and "a good policy tool, giving a clear political signal and impetus to action"). This target translates into a specific share for RES-electricity consumption of 22.1%
White Paper for a Community Strategy and Action Plan	For the above target—doubling the RES share of the current energy market—shares for individual technology sectors are outlined (p.11). Biomass is expected to increase the most—to meet the 12% target for RES overall, the *biomass sector's current level should TRIPLE*
COM(97)599 final (26/11/1997)	*Doubling of the current electricity and heat production from renewables PLUS a significant increase of biofuel in transport fuel by 2010* are "important elements in the scenario for achieving the overall Union objective"
Endorsed by the Council and the European Parliament in 1998 (OJ C 198,24.6.1998,p.1 and OJ C 210,6.7.1998,p.215, respectively)	*Energy RTD programme budgets give priority to RES* *Market Instruments Identified* *Access for RES into the electricity market/networks at fair prices*—guidelines given on price to paid to RES-electricity generators *Fiscal and Finance Measures*—tax exemption or reduction on RES energy products; flexible depreciation; financing incentives (soft loans, credit guarantees); start-up subsidies; public funds; financial incentives for consumers to purchase RE equipment and services… (p.16) …EU to work on guidelines and risk evaluation schemes to help banks to audit RES businesses applying for loans (p.26)

Table 3 (*continued*)

Legislation ID	Summary/selected excerpts
	Detaxation and subsidization of raw material production for bioenergy (New Bioenergy Initiative for Transport, Heat, and Electricity)—as of 1997, was available on a limited, pilot scale via Directive 92/81/EEC (per RES White Paper); however other proposals have been made to allow large-scale biofuels detaxation (e.g., proposal attached to Communication COM (2001) 547). For liquid biofuels, in particular, a high rate of tax relief is suggested (p.17)

Source: Ref. [14].

5.1. The drivers in agro-waste energy usage

From the policymaker's viewpoint, the use of agricultural waste for energy offers a number of national and international benefits. Benefits include [15–18]:

- lower emissions to the environment, in particular CO_2, the main greenhouse gas,
- reduced energy cost to the user, providing additional competitiveness for industrial and commercial users, and offering affordable heat for domestic users,
- large fuel cost savings,
- an opportunity to move towards more decentralized forms of electricity generation, where a plant is designed to meet the needs of local customers, avoiding transmission losses and increasing flexibility in system use,
- improved local and general security of energy supply,
- an opportunity to increase the diversity of power generation plants, and provide competition in generation,
- increased employment, especially in rural and farming communities—a number of studies have now concluded that the development of biomass energy systems is a generator of jobs, and
- economic development and growth in the agricultural sector.

In Turkey, there are also substantial areas of abandoned agricultural land that are not managed and are becoming overgrown. Creating demand for biomass fuel would help to bring these areas back into economic exploitation. Furthermore, development of new dedicated energy crops and/or an energy market for residues from existing crops would help farm income and reduce the rate of land abandonment.

From an investor's viewpoint, the primary reason for investment is to achieve an appropriate rate of return that is commensurate with the risk involved. Investors, however, also have other motives, and these include protection of the environment, compliance with regulations, alignment with other business activities, and social responsibility—many of which are similar to the policymaker's benefits identified above.

5.2. Potential agricultural policy and market instruments

In accordance with the findings of the EU agricultural policy and legislation review in Section 4.1, potential policy instruments appropriate for Turkey may

include [19–22]:

i. A policy or program to encourage alternative, beneficial uses of agricultural residues and wastes, in particular for biomass energy production, and potentially to encourage planting of energy crops.
ii. A rural development policy that considers renewable energy source exploitation in general, including agricultural waste exploitation and energy crops.
iii. Development and compliance of existing Turkish legislation with EC directives.
iv. Animal by-products legislation that would include rules for managing animal manure, which is a viable agricultural waste for biomass energy generation.

Turkey's agricultural industry and available rural land are both large and extensive. The policies/programs suggested in Items (i) and (ii) could have far-reaching effects on agricultural waste exploitation in Turkey. These policies/programs could also contribute to the growth of the agricultural sector and rural employment.

Costs associated with a compliance program for manure management could encourage consideration of alternatives uses of manure (to avoid costly disposal), including energy production.

Potential market instruments appropriate for Turkey could include: Financial incentives, by means of direct grants, loans, or subsidies, which would support better use of agricultural by-products (including residues and wastes) in a manner that promotes environmental protection, renewable energy, and overall performance efficiency.

5.3. Potential environmental policy and market instruments

In accordance with the findings of the EU environmental policy and legislation review in Section 4.2, potential policy instruments appropriate for Turkey might include:

i. Modifications or additions to existing waste management regulations which explicitly encourage the use of waste as a source of energy, along with general language promoting recycling and re-use with the relevant incentives.
ii. Modifications or additions to existing incineration and combustion plant legislation and air emission limits that explicitly consider biomass plants or biomass plants that co-incinerate, in order to ensure technologically and environmentally sound implementation.
iii. Modifications or additions to existing landfill regulations or establishment of a separate policy that sets a target for the reduction of biodegradable waste, or specifically agricultural crop wastes and residues, that is sent to landfills.
iv. Establishment of a ban on open burning of agricultural wastes and residues.

It should be noted that air emissions limits do exist in Turkey for biomass-fueled plants, and with the exception of dust, it appears the limits are generally compliant with EU limits in the Large Combustion Plants Directive. EU incineration limits are not directly comparable. If the limits that can be specified in Turkey are not sufficiently protective, technological standards can also be developed.

5.4. Potential renewable energy policy and market instruments

Currently, there are some relevant energy-related incentives applied in Turkey, as mentioned earlier regarding the Electricity Market Licensing Regulation, such as not applying license fees and priority distribution connection for renewables. The legislation discussed in Section 2.2 prepared by the MENR also brought some other incentives such as an obligation to purchase electricity from renewable energy sources, and purchasing of electricity from renewable energy sources with a higher price. This would also allow certain renewable energy projects to be built and operated by the private sector and would provide incentives for such a system.

The MENR, the State Planning Organization (DPT), and the Electric Power Resources Survey and Development Administration (EIEI) are involved in renewable energy promotion policies. Currently, however, they have made more instruments and incentives available for the development and implementation of geothermal heat and solar thermal energy. These include low-interest loans for up to 45% of the capital cost for appropriate investments. Biomass energy, though, is not included in these incentive programs, except as described earlier in the existing Licensing Regulation and the renewable energy law. Turkey has many more incentives now in terms of research and development for renewable energy, including biomass. These are covered in Section 5.5.

Before the recent introduction of the Free Market Law of Electricity, the price of energy was decided as a result of negotiations between the energy production companies and the state, which is the buyer. Now, the price of the renewable energy will have to obey market conditions, emphasizing the need for additional policy and market instruments to improve the competitiveness of renewable energy sources.

In accordance with the findings of the EU energy policy and legislation review in Section 4.3, potential energy policy instruments appropriate for Turkey may include:

i. Policy or legislation establishing a target (e.g., 10%) for the penetration of renewable energy sources into the gross domestic energy consumption by a given year, potentially with interim targets to ensure the country stays on track with the goal. This could include separate but integrated targets for heat and electricity produced from renewable energy sources. It could also include a separate but integrated target for biomass alone. For example, to meet the 12% overall renewables' penetration target in the EU, the existing biomass market share (at the time of policy development) should increase by 300%.
ii. Policy or legislation establishing a target for the penetration of biofuels into the gasoline and diesel transport fuel market by a given year, potentially with interim targets to ensure the country stays on track with the goal.

Potential energy-related market instruments appropriate for Turkey could include:

i. Exemption or reductions in the level of taxation to electricity, heat, and/or transport fuels produced with biomass sources.
ii. Other financial support mechanisms such as soft loans, low-interest loans, credit guarantees, start-up subsidies and/or Grants, and discounts for consumers willing to purchase related services.

Governmental support for the potential market instruments would not necessarily need to continue indefinitely. It may only be essential during periods of development and transition to obtain and maintain investor confidence.

5.5. Research and development incentives for renewable energy

With respect to R&D incentives for renewable energy, the Technology Monitoring and Evaluation Board (TIDEB) of TUBITAK, Electrical Power Resources Survey and Development (EIEI), and DPT act as implementing agencies. The applicable ministries also play a role. Overall, at present, about 15 types of legal and administrative incentives exist to promote R&D.

For example, TUBITAK-TIDEB has an R&D assistance program for industrial companies. This includes a financial contribution by TUBITAK and by the Undersecretary of Foreign Trade for up to 60% of the total eligible cost incurred over the duration of an individual R&D project (up to 36 months). Also, low-interest loans are provided by the Technology Development Foundation of Turkey (TTGV) for R&D projects within the scope of the decree.

The other legal and administrative incentives to promote R&D are:

a. *The decree on investment incentives*. The decree covers R&D, environmental and quality improvement, and small medium-sized enterprises (SMEs).
b. *A tax credit for R&D expenses*. This credit makes it possible to postpone payment of annual corporate taxes for 3 years without interest up to an amount equivalent to 20% of R&D expenses.

While financing of R&D projects is offered via national funds by organizations like DPT and TUBITAK-TIDEB, and via research funds of universities, the budgets are quite small. International co-operation is sought not only in terms of funding but also in terms of information exchange and exchange of "know-how" [5]. In this context, Turkey has joined the European Union's 6th Framework Program, through which there are many project opportunities related to renewable energy. Turkey's universities and research institutes have begun to receive project funding from the EU through this program.

R&D projects proposed in the areas of cost-effective power production from municipal wastes and forest and agricultural residues, the development of fluidised bed technology for using biomass/coal blends in thermal power plants, the development of technologies using energy crops as fuel for power/heat production, and the development of technologies for pyrolysis, gasification and liquid fuel production from biomass. These topics are openly encouraged by TUBITAK-TIDEB and DPT. The industrial sector and the municipalities are primarily interested in larger scale, cost-effective, profitable and applicable R&D projects.

Turkey itself allotted 450 million YTL for R&D efforts inside of the country in 2005. In 2006, this amount has been increased to 900 million YTL. The management of this financial resource has been given to TUBITAK. Turkey's priority with regard to energy is renewable energy, which holds great potential for the country. The main supported renewable energy sources are solar energy, geothermal energy and wind energy. However, developments toward biological-based fuel technology demonstration and R&D studies

(such as direct energy production from biomass and production of liquid biogas) have been improved [3].

6. Identification of barriers to agricultural waste exploitation

The barriers inhibiting agricultural waste exploitation in Turkey can be generally summarized as follows: (1) barriers in the institutional, legal, and administrative framework and (2) real and perceived risks and other inherent difficulties associated with promoting biomass energy. These barriers are discussed in further detail in the following sections, respectively.

6.1. Barriers in the institutional, legal, and administrative framework

The most important barriers identified to date in the institutional, legal, and administrative framework for the exploitation of the agricultural waste in Turkey are summarized in the bulleted list below:

- establishment of a responsibilities structure and organization at the institutional level, which requires a higher level of coordination and cooperation within and between institutions, agencies, institutes, and other stakeholders,
- limited authority at municipalities to obtain necessary data,
- insufficient available information about existing and possible future costs,
- insufficient detailed renewable energy resource assessments and data banks pertaining to Turkey,
- recovery of insufficient revenue from local taxes,
- insufficient local income sources and responsibility,
- insufficient credit facilities, particularly for small-scale projects,
- administrative and time-consuming obstacles for foreign investors,
- need for support for infrastructure and management know-how at a local level,
- insufficient participation by the private sector,
- need for additional staff who have sufficient technical information,
- difficulties possibly encountered in planning, project feasibility, and project control activities,
- need for more efficient implementation of waste minimization policies,
- other insufficient policy and market instruments (including available subsidies) in the environmental, agricultural, and energy sectors,
- need for higher level of dissemination and promotion,
- need for public acceptance and willingness.

6.2. Real and perceived risks and other inherent difficulties in promoting biomass energy

In comparison to fossil fuels, biomass fuels are characterized by their low density, and sources of biomass are small, dispersed, disparate, and seasonal. Biomass fuels may be collected from, for example, individual farms covering a wide geographic area. Sources are very small in comparison to fossil fuel extraction industries, with the possible exception of the largest pulp and paper or wood processing units. These issues all contribute to

potentially elevated fuel costs—via logistics, contracting, transport, fuel preparation, storage, etc.

A unique aspect of many agricultural waste materials is their seasonality. The seasonality of agriculture is seen to be a key risk, for both establishing viable fuel supply businesses and for maintaining year-round fuel supplies for potential energy plants.

The high capital cost of agricultural waste or biomass power plants is a major disincentive to investors. Further, the upper size limit of biomass plants is lower than fossil fuel-fired plants, because long-distance transport of low-density biomass fuels is generally not considered feasible (for financial and environmental reasons). There are limited opportunities to achieve economies of scale with bio-energy. Thus, to achieve favorable power and heat generation costs, technology with high fuel conversion efficiency is selected. For example, gasification technologies enable higher electrical conversion efficiencies than conventional combustion boiler plants. There is also considerable interest in pyrolysis for the same reason.

Nonetheless, while improved technology may be able to battle some of the elevated investment costs of bio-energy, technology risks remain. Some relevant technology is proven, however a lot of technology remains in research, development, and demonstration phases. This technology risk is considered unacceptable to most investors.

Another important consideration is that the core business for the wood or agro-industry plant owners and managers is not energy. If a capital sum is available for investment, improvements to their core business are likely to take precedence over any potential energy-related business expansion. However, entities that are market leaders in their field with a limited scope for further product/process improvement are perhaps more likely to examine diversification opportunities and view energy export as a new business opportunity.

In many countries, universities have also been noted to not sufficiently educate engineers about renewable energy technologies. Appropriately skilled staff will be necessary for future biomass and other renewable energy developments. Also, these individuals may, in the future, hold decision-making roles in energy plant investments. Giving students awareness and knowledge of successful renewable energy technologies is important for building acceptance and helping them to recognize the feasibility for renewable energy projects in the future.

7. Identification of gaps and formulation of recommendations

The use of agricultural waste already occurs in some industries in Turkey on a small scale [23]. However, because of the financial and technical barriers to biomass energy in Turkey, as discussed above, and insufficient policy/market instruments, the private sector is not yet seriously interested in biomass and waste-fuelled energy plants.

In order to encourage investment by reducing technical barriers, a number of measures can be recommended. First of all, technology that is developed and/or transferred needs standardization and then replication. Applied biomass technologies should be evaluated in detail as a pre-condition for technology transfer. Cooperation with European Member States in related technology areas should also be expanded. Improving data availability, quality, and completeness will also reduce technical barriers. Improved data should include residual or waste type, availability, quantities, and location. Additionally, the energy

supply and demand should be closely monitored and the forecasts must be revised to take account of the progress of liberalization, energy efficiency improvements, structural changes in industry, and other major factors in order to better inform all players' investment decisions.

To encourage investment by mitigating financial barriers, high initial capital costs, high operation and management costs, and risky fuel supply costs must be brought down or subsidized. Local production of renewable energy technology can reduce the investment costs significantly.

Appropriate policy development can also help to mitigate cost issues. Appropriate financial mechanisms must be implemented by the public sector to mitigate the risks of project investment. Implementation of the potential market instruments identified in Sections 5.2, 5.3, and 5.4 is recommended. These include:

- financial incentives (e.g., direct Grants, loans, and/or subsidies) supporting the better use agricultural by-products,
- environmental taxes or penalties that would discourage landfilling of agricultural waste or environmentally unsound management of agricultural wastes,
- exemptions or reductions in the level of taxation for electricity, heat, and/or transport fuels produced with biomass sources, and
- energy investment-related financial support mechanisms such as special loans, start-up subsidies and/or Grants.

Market instruments considered to be of highest priority are the latter two energy-related instruments—tax exemptions or reductions and other energy investment-related financial support mechanisms. These are expected to provide the most immediate benefit for improving investor confidence.

In addition to these market instruments is another growing classification of tools that is more tailored to the market than relatively straightforward capital Grants or subsidies. For example, there is a rapidly growing market in the EU in greenhouse gas emission credits/trading and renewable energy certificates, which are backed respectively by emissions caps and mandatory obligations on utilities. Other broad mechanisms include carbon and energy taxes. These kinds of incentives have considerable value and can make otherwise financially unattractive installations viable. They also have wider effects on energy savings, energy efficiency, and renewable energy. Such market instruments could effectively promote biomass and other renewable energy forms in Turkey, as well. However, it should be noted that to date most incentives have focused on electricity, and heat has generally been excluded. The exclusion of heat is due to the dispersed and complex nature of heat (e.g., heat energy efficiencies and the heat market are much more difficult to measure) and its perceived unimportance. The heat market in Turkey should be considered vital and given additional attention.

Overall, relative to the current status of policy and legislation in the EU that promotes agricultural waste exploitation, Turkey has many gaps to fill. With the exception of the one existing law and the law described in Section 2.2, no other policy or market incentives exist. All potential instruments identified in Sections 5.2, 5.3, and 5.4 could be implemented in Turkey to bring the country to the same level as the EU. In addition to the

abovementioned priority market instruments designed to address cost issues, recommended priority policy instruments include:

- a policy or program to encourage alternative, beneficial uses of agricultural residues and wastes, in particular for biomass energy production, and potentially to encourage planting of energy crops,
- modifications or additions to existing landfill regulations or establishment of a separate policy that sets a target for the reduction of biodegradable waste, or specifically agricultural crop wastes and residues, sent to landfills,
- policy or legislation establishing a target for the penetration of renewable energy sources into the gross domestic energy consumption, potentially with interim targets to ensure the country stays on track with the goal and potentially with separate but integrated targets for RES-heat, RES-electricity, and/or biomass sources, and
- policy or legislation establishing a target for the penetration of biofuels into the gasoline and diesel transport fuel market, potentially with interim targets to ensure the country stays on track with the goal.

The recommended market and policy instruments are not only energy sector-specific, but agricultural and environmental, as well. These three areas are interrelated and must be considered both individually and collectively.

Three other specific recommendations remain with significant environmental implications. These are related to use of wood and wood residue, co-generation of biomass and coal, and biomass plant emission limits. First, it has been recognized that market demand for biomass fuels already exists in Turkey, including in rural areas, where a large number of people generate income through the trade of wood and wood residues, primarily for cooking purposes. However, with regard to both the supply and demand sides of wood fuels from both forest and non-forest sources, technologies and methodologies need to be modernized. Existing approaches are inefficient, uneconomical, and environmentally undesirable because they are essentially just open burning. Technological standards and incentives supporting advancement in technology are recommended for implementation. Second, co-generation of biomass with coal could be encouraged where coal is currently used; this will reduce the emissions of those existing power generation systems and make a considerable contribution to greenhouse gas emission reductions. Third, with the exception of dust, it appears Turkish biomass-related air emission limits are generally compliant with EU limits in the Large Combustion Plants Directive. Dust emission limits, however, could be reduced significantly. If the limits that can be specified in Turkey are not sufficiently protective, technological standards can also be developed.

The role of the government in formulating and implementing favorable policies for agricultural waste exploitation is vital. While specific policies and regulations are recommended, it is also important for efficiency and effectiveness that communication and mechanisms for coordination/cooperation between ministries (i.e. energy, agricultural, and environmental) be improved. Successful policymaking and implementation can lead to an ultimately important outcome—the private sector, which has the capacity to mobilize needed funds, must be motivated to participate in biomass and other renewable energy development.

The process of liberalization, restructuring, and privatization in the energy sector is also vital. It should be continued without any delays in the introduction of competition. This will assist in creating a favorable environment for investment.

While biomass fuel supply is an area fraught with difficulties, experience has shown that biomass fuel supply can integrate well with existing wood and agricultural production activities, providing additional revenue opportunities for existing forestry and agricultural operators/contractors and potential opportunities for new specialized biomass fuel supply specialists to be established. Advancements and technical developments take place with increasing scales of activities, which further leads to reduced prices, improved quality (i.e. conformance to specific standards), and improved reliability in supplies. In combination with appropriate policy and market instruments, plus R&D support, needed investments can be mobilized and agricultural waste exploitation in the form of biomass energy can be successfully promoted and implemented on a wider basis in Turkey.

8. Conclusions

The influence of non-technical issues on the exploitation of agricultural waste in Turkey has been investigated. The issues involve the legislative framework and the organizational structure of the Turkish administration relevant to agricultural waste exploitation. The study has aimed to transfer the European experience and practices relative to the overall framework of managing agricultural waste. In this context, the institutional and administrative framework with respect to agricultural waste exploitation has been analyzed and assessed.

In the study, the following items were identified or accomplished:

1. In Turkey, there are no laws or regulations explicitly and purposefully directed toward the exploitation of agricultural waste; however, within limited legislation, there are provisions related to agricultural waste exploitation that involve responsibilities, incentives, and limitations across agricultural, environmental and energy sectors. This legislation has been described in detail above.
2. It is acknowledged that energy development in Turkey has been dominated by public investment and management. However, the government wants to complete the process of liberalization, restructuring, and privatization of the energy sector. The country has made early and extensive use of financing models such as build-own-operate (BOO) and build-operate-transfer (BOT).
3. EU policy and legislation relevant to agricultural waste exploitation were researched and summarized. These policies are believed to be the most developed in the world for this topic, and they serve as a solid base for development of recommendations for Turkish policy.
4. Motivations for agricultural waste exploitation are identified and discussed along with potential policy and market instruments for incorporation into Turkish policy and legislation.
5. A number of barriers inhibiting agricultural waste exploitation in Turkey are identified and discussed.
6. Overall, relative to the current status of policy and legislation in the EU that promotes agricultural waste exploitation, it is recognized that Turkey has many

gaps to fill. Several policy and market instruments are recommended for inclusion in Turkish legislation. To guide initial steps, instruments that are believed to provide the greatest effects have been identified as those that should be assigned highest priority.
7. The importance of the role of the government in formulating and implementing favorable policies for agricultural waste exploitation is stressed. It is also important for efficiency and effectiveness that communication and mechanisms for coordination/cooperation between ministries (i.e. energy, agricultural, and environmental) be improved. Successful policymaking and implementation can lead to an ultimately important outcome:
8. Since the private sector has the capacity to mobilize needed funds, development of incentives that would motivate the private sector to become involved in the advancement of biomass and other renewable energy resources is emphasized.

Disclaimer: While various pieces of data have been referenced from governmental documents, this paper is not necessarily representative of the views of the Turkish goverment.

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